JAN 6 2009

282157

ɅAY CHANG [Hanway.Chang@uspto.gov]
.esday, January 06, 2009 4:27 PM
STIC-EIC2800
.t: Search Request, Case/Application No.: 10/562496

.iester: **HANWAY CHANG (P/2881)**
. Unit: **GROUP ART UNIT 2881**
.mployee Number: **85872**
Office Location: **CLC 33031**
Phone Number: **(571)270-5766**

Case/Application number: **10/562496**
Priority Filing Date: **06/27/2003**
Format for Search Results: **Email**
Is this a Board of Appeals case? **No, this is not a Board of Appeals case.**
Describe this invention in your own words:
Creating extreme ultraviolet or soft x-ray radiation though a laser source AND rapid electrical discharge from electrodes by formation of a plasma from a solid, liquid, or gas

Synonyms:
Extreme ultraviolet (EUV or XUV)

Additional comments:
Please search for independent claims 29 (method) and 42 (device). Finding one should automatically have the other and vice versa.

Attachment: **No**

Search History

10/562,496 1/9/09 **STN**

08:10:25 ON 09 JAN 2009
08:35:43 ON 09 JAN 2009

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FILE 'HCAPLUS, WPIX, JAPIO, KOREAPAT' ENTERED AT 08:11:43 ON 09 JAN 2009
L1         2510 SEA ABB=ON  (H05G2-00)/IPC,IC
L2         4638 SEA ABB=ON  (EUV# OR (EXTREME)(1A)(ULTRAVIOLET OR ULTRA VIOLET
                OR UV) OR (SOFT)(2A)(XRAY OR X RAY))(3A)(PRODUC##### OR MAK###
                OR FORM####### OR GENERAT##### OR SYNTHESIZ? OR SYNTHESIS? OR
                INDUCE# OR INDUCING OR PROPAGAT? OR FABRICAT? OR MANUFACTUR? OR CREAT####)
L3        76934 SEA ABB=ON  (X(1A) RADIAT? OR X(1A) IRRADIAT#### OR XRAY OR X
                RAY OR X(1A) PHOTON)(3A)(PRODUC##### OR MAK### OR FORM#######
                OR GENERAT##### OR SYNTHESIZ? OR SYNTHESIS? OR INDUCE# OR
                INDUCING OR PROPAGAT? OR FABRICAT? OR MANUFACTUR? OR CREAT####)
L4        80746 SEA ABB=ON  (L1 OR L2 OR L3)
L5         5983 SEA ABB=ON  L4 AND (EUV## OR EXTREME ULTRAVIOLET OR EXTREME UV
                OR (SOFT)(1A)(XRAY OR X RAY OR X(1A) RADIAT##### OR X(1A)IRRADIA#######))
L6         4615 SEA ABB=ON  L4 AND (PLASMA)(3A)(PRODUC##### OR MAK### OR
                FORM####### OR GENERAT##### OR SYNTHESIZ? OR SYNTHESIS? OR
                INDUCE# OR INDUCING OR PROPAGAT? OR FABRICAT? OR MANUFACTUR? OR CREAT####)
L7         1847 SEA ABB=ON  L5 AND (PLASMA)(3A)(PRODUC##### OR MAK### OR
                FORM####### OR GENERAT##### OR SYNTHESIZ? OR SYNTHESIS? OR
                INDUCE# OR INDUCING OR PROPAGAT? OR FABRICAT? OR MANUFACTUR? OR CREAT####)
L8         3349 SEA ABB=ON  (L4 OR L5) AND (LASER)(5A)(PLASMA)
L9          193 SEA ABB=ON  (L4 OR L5) AND (LPP OR GDPP OR LAGDPP OR DBLPP OR LBGDPP)
L10        2413 SEA ABB=ON  (L4 OR L5) AND (LASER)(2A)(BOOST#### OR ENHANC#####
                # OR INDUC##### OR PRODUC##### OR IONIS########## OR IONIZ##########)(2A)(PLASMA)
L11        5049 SEA ABB=ON  (L6 OR L7 OR L8 OR L9 OR L10)
L12        7209 SEA ABB=ON  (L4 OR L5) AND (LASER)
L13         327 SEA ABB=ON  (L4 OR L5) AND (EXCIMER)
L14        8650 SEA ABB=ON  (L11 OR L12 OR L13)
L15        4145 SEA ABB=ON  L14 AND (LASER OR COHERENT)(2A)(RADIAT##### OR
                IRRADN# OR RADN## OR IRRADIAT##### OR LIGHT OR PHOTON OR
                ILLUMINAT##### OR SOURCE OR BEAM)
L16          15 SEA ABB=ON  L11 AND (OPTICAL#####)(2A)(AMPLIFY### OR AMPLIFIE#### OR AUGMENT######)
L17        8650 SEA ABB=ON  (L11 OR L12 OR L13 OR L14 OR L15 OR L16)
L18         104 SEA ABB=ON  L17 AND (?ELECTRODE? OR ?ANODE? OR ?CATHODE?)(7A)((
                ELEC## OR ELECTRIC###### OR GAS OR STREAMER)(1A)(DISCHARG######
                #) OR (ELEC## OR ELECTRIC?)(2A)(ARC OR TREE### OR CORONA OR SPARK###))
L19         350 SEA ABB=ON  L17 AND (?ELECTRODE? OR ?ANODE? OR ?CATHODE?)(7A)(DISCHARG##########)
L20         355 SEA ABB=ON  (L18 OR L19)
L21           7 SEA ABB=ON  L17 AND ((ELEC## OR ELECTRIC###### OR GAS OR
                STREAMER)(1A)(DISCHARG#######) OR (ELEC## OR ELECTRIC?)(2A)(ARC
                OR TREE### OR CORONA OR SPARK###))(3A)(RAPID#### OR FAST###
                OR SUPERFAST? OR ULTRAFAST OR ULTRARAPID OR QUICK? OR SPEED####
                OR HIGH RATE OR NANOSECOND OR MILLISECOND OR MICROSEC?)
L22         359 SEA ABB=ON  ((L20 OR L21))
L23         200 SEA ABB=ON  L22 AND (?ELECTRODE? OR ?ANODE? OR ?CATHODE?)(6A)(PLASMA)
L24          13 SEA ABB=ON  L22 AND (LASER)(8A)(TARGET OR FOIL OR SOLID OR
                SURFACE OR (GAS#### OR VAPOR####### OR VAPOUR####### OR
                LIQUID####### OR FLUID####)(2A)(SPRAY####))
L25          12 SEA ABB=ON  L22 AND (LASER)(6A)(FOCUS######## OR FOCAL OR INTENSIT#####)
L26           2 SEA ABB=ON  L22 AND (TIME OR TIMING OR TIMED OR TIMER)(2A)(CONS
                TANT OR VARIABLE OR PARAMETER OR VALUE)
L27         109 SEA ABB=ON  L22 AND ?LITHOGRAPH?
L28          64 SEA ABB=ON  L27 AND (ELECTRODE)
L29           2 SEA ABB=ON  L27 AND (U11-C04K)/MC
L30           2 SEA ABB=ON  L22 AND (U11-C04K)/MC
L31           0 SEA ABB=ON  L22 AND (U11-C04H1)/IPC,IC
L32           4 SEA ABB=ON  L22 AND (NANOSECOND OR NANO SECOND OR PICOSECOND OR PICO SECOND)
L33           3 SEA ABB=ON  L22 AND (RAPID)(2A)(DISCHARG#####)
L34           2 SEA ABB=ON  L22 AND (TIME CONSTANT)
L35           3 SEA ABB=ON  L22 AND (PLASMA)(4A)(PATH####)
L36           4 SEA ABB=ON  L22 AND (PLASMA)(4A)(EXPAND##### OR EXPANS######)
L37          94 SEA ABB=ON  L22 AND (PINCH###)
L38          12 SEA ABB=ON  L22 AND (PINCH)(1A)(EFFECT)
L39           7 SEA ABB=ON  L22 AND (LPP OR GDPP OR LAGDPP OR DBLPP OR LBGDPP)
L40         110 SEA ABB=ON  L22 AND (GAS#### OR VAPOR##### OR VAPOUR#####)(2A)(DISCHARG######)
L41          76 SEA ABB=ON  L22 AND (13###)
L42           2 SEA ABB=ON  L22 AND (LASER)(3A)(FOCUS##########)(3A)(INTENSIT#####)
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L43        1 SEA ABB=ON  L22 AND (SYNERG######)
L44        2 SEA ABB=ON  L22 AND (LASER)(2A)(REGION OR AREA OR ZONE OR TARGET)
L45        1 SEA ABB=ON  L22 AND EUVL
L46        2 SEA ABB=ON  L22 AND (CRYOGENIC?)
L47      322 SEA ABB=ON  L22 AND (PLASMA) AND (DISCHARG?)
L48        0 SEA ABB=ON  L22 AND (PLASMA)(2A)(COMBO OR COMBINAT###### OR
             COMBIN#####) AND (DISCHARG?)
L49       13 SEA ABB=ON  L22 AND (LASER)(2A)(SOURCE)
L50       32 SEA ABB=ON  L22 AND (EUV# OR EXTREME ULTRAVIOLET OR SOFT XRAY
             OR SOFT X RAY)(2A)(EMIS? OR EMIT?)
L51       10 SEA ABB=ON  L22 AND (PLASMA)(2A)(HEAT#####)
L52      238 SEA ABB=ON  (L24 OR L25 OR L26) OR (L27 OR L28 OR L29 OR L30
             OR L31 OR L32 OR L33 OR L34 OR L35 OR L36 OR L37 OR L38 OR
             L39) OR (L41 OR L42 OR L43 OR L44 OR L45 OR L46) OR (L49 OR L50 OR L51)
L53      218 SEA ABB=ON  L52 AND P/DT
L54       20 SEA ABB=ON  L52 NOT L53
L55        9 SEA ABB=ON  L54 NOT 2004-2009/PY
L56      144 SEA ABB=ON  L53 AND 1980-2003/PRY,PY
L57      125 SEA ABB=ON  L53 AND 2004-2009/PRY,PY
L58       93 SEA ABB=ON  L53 NOT L57
L59      153 SEA ABB=ON  L58 OR L56 OR L55
             D L59 ALL MEMBB 1-153
```

L59 ANSWER 16 OF 153 COPYRIGHT ACS on STN
AN 2001:904791 HCAPLUS
DN 136:45416
ED Entered STN: 14 Dec 2001
TI Plasma focus light source with active and buffer gas control
IN Birx, Daniel L.; Melnychuk, Stephan T.; Partlo, William N.; Fomenkov, Igor V.; Ness, Richard M.; Sandstrom, Richard L.; Rauch, John E.
PA Cymer, Inc., USA
SO PCT Int. Appl., 47 pp.
CODEN: PIXXD2
DT **Patent**
LA English
IC ICM H01J035-20
CC 73-11 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 74, 76
FAN.CNT 186

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
	-------------	----	--------	------------------	--------
PI	WO 2001095362	A1	20011213	WO 2001-US18680	20010607 <--
	US 20020014598	A1	20020207	US 2001-875719	20010606 <--
	US 6586757	B2	20030701		
	AU 2001068288	A	20011217	AU 2001-68288	20010607 <--
	EP 1305813	A1	20030502	EP 2001-946210	20010607 <--
	JP 2004501491	T	20040115	JP 2002-502807	20010607 <--
PRAI	US 2000-590962	A	20000609 <--		
	US 2000-690084	A	20001016 <--		
	US 2001-875719	A	20010606 <--		
	US 1997-854507	A2	19970512 <--		
	US 1998-93416	A2	19980608 <--		
	US 1999-268243	A2	19990315 <--		
	US 1999-324526	A2	19990602 <--		
	US 1999-442582	A2	19991118 <--		
	WO 2001-US18680	W	20010607 <--		

AB High energy **extreme UV** (**EUV**) photon sources are described which comprise a vacuum chamber, at least two electrodes mounted co-axially within the vacuum chamber and defining an elec. discharge region and arranged to **create** high frequency **plasma pinches** at a **pinch** site upon elec. discharge, a working gas comprising an active gas and a noble buffer gas (e.g., He), a gas control system for supplying the buffer gas and the active gas to the vacuum chamber and exhausting gas from the vacuum chamber so as to maintain the active gas at a desired concentration in the discharge region and minimize the active gas in the beam path outside the discharge region, a pulse power system comprising a charging capacitor and a magnetic compression circuit the magnetic compression circuit comprising a pulse transformer for providing elec. pulses and voltages high enough to create **elec. discharge** between the **electrodes** , a collector-director unit configured to collect **EUV** beams from the **pinch** site and direct them along a predetd. path, and a debris collector mounted near the **pinch** site and comprising narrow passageways aligned with **EUV** beams emanating from the **pinch** site and directed toward the collector-director. Preferably, active gas is injected downstream of the **pinch** region through a nozzle and exhausted axially through an exhaust port in the center of the anode. A **laser beam** may be used to generate a metal vapor (e.g., Li) active gas at a location close to but downstream of the **pinch** region and the vapor is exhausted axially through the anode. Application as a light source for **lithog.** is indicated.
ST plasma focus **extreme UV** source gas control

L59 ANSWER 112 OF 153 (C) JPO on STN
AN 1996-167753 JAPIO
TI X-RAY PREPARATORY IONIZATION DISCHARGE EXCITED GAS **LASER** APPARATUS AND ITS OSCILLATING METHOD
IN SEKIDA HITOSHI
PA NEC CORP
PI JP 08167753 A **19960625** Heisei
AI JP 1994-311694 (JP06311694 Heisei) 19941215
PRAI JP 1994-311694 **19941215**
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 1996
IC ICM H01S003-0977
AB PURPOSE: To miniaturize an X-ray preparatory ionization discharge excited gas **laser** apparatus, to lower the operating voltage, to reduce the Power demand, and to enhance the safety by generating X-rays with high efficiency.
CONSTITUTION: An **X-ray generating laser beam** 2 **generated** by an **X-ray generating laser** apparatus 1 is **focused** linearly by a cylindrical mirror 3, penetrates a total reflection mirror 9, and irradiates a **discharging electrode** 5. A part of the **discharging electrode** 5 becomes **plasma** by a **laser beam**, and **X-ray** is **generated.** By this **X-ray**, the gas in the space between **discharging electrodes** 5 and 6 is ionized. A **laser beam** 8 is oscillated by applying high voltage to the **discharging electrodes** 5 and 6 with a high-voltage power source 11 synchronized with the **X-ray generating laser** apparatus 1, and exciting the gas inside the **laser** container 4.

DE Priority date:
12/19/2002

L59 ANSWER 7 OF 153
AN 2004:587867 HCAPLUS
TI **Extreme ultraviolet** radiation sources with high average radiating power
IN Ahmad, Imtiaz; Schriever, Guido; Goetze, Sven; Kleinschmidt, Juergen; Stamm, Uwe
PA XTREME Technologies GmbH, Germany
SO Ger., 21 pp.
CODEN: GWXXAW
DT **Patent**
LA German
IC ICM H01J061-70
ICS **H05G002-00**; H05H001-48; H01J015-02

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	DE 10260458	B3	20040722	DE 2002-10260458	20021219 <--
	US 20040145292	A1	20040729	US 2003-741882	20031219 <--
	US 6815900	B2	20041109		
PRAI	DE 2002-10260458	A	20021219 <--		

AB Plasma **extreme UV** sources which employ 2 electrodes which are elec. isolated from each other which are contained in **electrode** housings that are rotationally sym. and which for a portion of a vacuum chamber in which a **plasma** can be **formed** and from which light may be emitted via an opening in the first **electrode** housing are described in which the second **electrode** housing has a neck region enclosing a collar for the **electrode**, the first **electrode** housing overlapping concentrically the neck region of the second **electrode** housing; a concentric insulator layer is provided between the concentric surfaces of the **electrode** housings (so that the **gas discharge** is essentially only parallel to the symmetry axis of the **electrode** housings) and the **electrode** collar is graded away radially from the insulator layer so that, at least at the end of the collar, there is a division in the form of a concentric separation between the layer and the collar. Appropriate heat sink systems are also described. Application in **lithog.** (e.g., for semiconductor device fabrication) is indicated.
ST plasma **extreme UV** source concentric **electrode** section isolation
IT **Electrodes**
(**discharge**; **extreme UV** radiation sources with concentric **electrode** sections)
IT **Electric discharge** devices
(**extreme UV** radiation sources with concentric **electrode** sections)
IT Noble gases, uses
RL: DEV (Device component use); USES (Uses)
(fill mixts. containing; **extreme UV** radiation sources with concentric **electrode** sections)
IT Heat sinks
(for **extreme UV** radiation sources with concentric **electrode** sections)
IT Borosilicate glasses
RL: DEV (Device component use); USES (Uses)
(lead borosilicate; **extreme UV** radiation sources with concentric **electrode** sections)

L59 ANSWER 8 OF 153

AN 2004:247087 HCAPLUS

ED Entered STN: 25 Mar 2004

TI Radiation source, **lithographic** apparatus, and device manufacturing method

IN Koshelev, Konstantin Nikolaevitch; Banine, Vadim Yevgenyevich; Ivanov, Vladimir Vitalievich; Kieft, Erik Rene; Loopstra, Erik Roelof; Stevens, Lucas Henricus Johannes; Sidelkov, Yurii Victorovitch; Koloshnikov, Vsevolod Grigorevitch; Krivtsun, Vladimir Mihailovitch; Gayazov, Robert Rafilevitch; Frijns, Olav Waldemar Vladimir

PA ASML Netherlands B. V., Neth.

SO Eur. Pat. Appl., 27 pp.
CODEN: EPXXDW

DT **Patent**

LA English

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE	
	---------------	----	--------	--------------------	--------	
PI	EP 1401248	A2	20040324	EP 2003-255825	20030917	<--
	CN 1497349	A	20040519	CN 2003-164836	20030917	<--
	JP 2004165155	A	20040610	JP 2003-363845	20030917	<--
	TW 266962	B	20061121	TW 2003-92125623	20030917	<--
	SG 129259	A1	20070226	SG 2003-5633	20030917	<--
	EP 1406124	A1	20040407	EP 2003-256180	20030930	<--
	CN 1498056	A	20040519	CN 2003-164931	20030930	<--
	JP 2004165160	A	20040610	JP 2003-376283	20030930	<--
	JP 4188208	B2	20081126			
	US 20040141165	A1	20040722	US 2003-673644	20030930	<--
	US 6933510	B2	20050823			
	TW 252377	B	20060401	TW 2003-92127062	20030930	<--
	SG 127702	A1	20061229	SG 2003-5749	20030930	<--
	KR 2004031601	A	20040413	KR 2003-68466	20031001	<--
	US 20050253092	A1	20051117	US 2005-187860	20050725	<--
	JP 2007019031	A	20070125	JP 2006-211722	20060803	<--
	JP 2007305992	A	20071122	JP 2007-120962	20070501	<--
PRAI	EP 2002-256486	A	20020919	<--		
	~~EP 2002-256907~~	~~A~~	20021003	<--		
	JP 2003-363845	A3	20030917	<--		
	JP 2003-376283	A3	20030930	<--		
	US 2003-673644	A1	20030930	<--		

AB Radiation (e.g., **extreme UV** radiation) sources comprising an anode and a cathode that are configured and arranged to create a discharge within a discharge element in a substance in a **discharge** space between the **anode** and the **cathode** to **form** a **plasma** so as to **generate** electromagnetic radiation are described in which the radiation source comprises a plurality of discharge elements and/or which are provided with a triggering device for initiating the discharge by irradiating a surface proximate the discharge space with an energetic beam. The substance may comprise xenon, indium, lithium, iridium, and/or tin. Because the radiation source comprises a plurality of discharge elements, heat dissipation may be improved by using each element for short intervals, after which another discharge element is selected. Methods for operating the sources in a self-triggering regime are also described. **Lithog.** projection apparatus comprising the sources and methods for device fabrication using the apparatus is also described.

ST discharge radiation source **lithog** projection app device fabrication; UV source **lithog** projection app

Please note: PRAI
Priority filing dates.
i.e. 6/09/2000

L59 ANSWER 5 OF 153 COPYRIGHT ACS on STN
AN 2004:681127 HCAPLUS
DN 141:197177
ED Entered STN: 20 Aug 2004
TI Discharge **produced plasma EUV** light source
IN Partlo, William N.; Blumenstock, Gerry M.; Bowering, Norbert; Bruzzone, Kent; Cobb, Dennis; Dyer, Timothy S.; Dunlop, John; Fomenkov, Igor V.; Hysham, James Christopher; Oliver, I. Roger; Palenschat, Frederick; Pan, Xiaojiang; Rettig, Curtis L.; Simmons, Rodney D.; Walker, John; Webb, R. Kyle; Hofmann, Thomas
PA USA
SO U.S. Pat. Appl. Publ., 35 pp., Cont.-in-part of U.S. Pat. Appl. 2004 108,473.
CODEN: USXXCO
DT **Patent**
LA English
IC ICM H01J017-26
ICS H01J061-28
INCL 313231310
CC 73-11 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 57, 76
FAN.CNT 186

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE	
PI	US 20040160155	A1	20040819	US 2003-742233	20031218	<--
	US 7180081	B2	20070220			
	US 20020014598	A1	20020207	US 2001-875719	20010606	<--
	US 6586757	B2	20030701			
	US 20020014599	A1	20020207	US 2001-875721	20010606	<--
	US 20030006383	A1	20030109	US 2002-189824	20020703	<--
	US 6815700	B2	20041109			
	US 20030219056	A1	20031127	US 2003-384967	20030308	<--
	US 6904073	B2	20050607			
	US 20040108473	A1	20040610	US 2003-409254	20030408	<--
	US 6972421	B2	20051206			
	TW 275325	B	20070301	TW 2004-93104595	20040224	<--
	WO 2004081503	A2	20040923	WO 2004-US6551	20040303	<--
	EP 1602116	A2	20051207	EP 2004-716949	20040303	<--
	JP 2006520107	T	20060831	JP 2006-509069	20040303	<--
	US 20070023711	A1	20070201	US 2006-493945	20060726	<--
	US 7291853	B2	20071106			
PRAI	US 2000-590962	B2	20000609	<--		
	US 2000-690084	A2	20001016	<--		
	US 2001-875719	A2	20010606	<--		
	US 2001-875721	A2	20010606	<--		
	US 2002-120655	A2	20020410	<--		
	US 2002-189824	A2	20020703	<--		
	US 2002-419805P	P	20021018	<--		
	US 2002-422808P	P	20021031	<--		
	US 2003-384967	A2	20030308	<--		
	US 2003-409254	A2	20030408	<--		
	US 1997-854507	A2	19970512	<--		
	US 1998-93416	A2	19980608	<--		
	US 1999-268243	A2	19990315	<--		
	US 1999-324526	A2	19990602	<--		

US 1999-442582	A2	19991118	<--
US 2000-696084	A2	20001016	<--
US 2001-771789	A2	20010129	<--
US 2001-829475	A2	20010409	<--
US 2001-848043	A2	20010503	<--
US 2001-854097	A2	20010511	<--
US 2001-943343	A2	20010829	<--
US 2001-991	A2	20011114	<--
US 2001-6913	A2	20011129	<--
US 2001-36676	A2	20011221	<--
US 2001-36727	A2	20011221	<--
US 2002-141216	A2	20020507	<--
US 2002-233253	A2	20020830	<--
US 2002-412349P	P	20020920	<--
US 2002-426888P	P	20021115	<--
US 2003-442579P	P	20030124	<--
US 2003-443673P	P	20030128	<--
US 2003-445715P	P	20030207	<--
US 2003-742233	A	20031218	<--
WO 2004-US6551	W	20040303	

AB An DPP **EUV** source is disclosed which may comprise a debris mitigation apparatus employing a metal halogen gas producing a metal halide from debris exiting the plasma. The **EUV** source may have a debris shield that may comprise a plurality of curvilinear shield members having inner and outer surfaces connected by light passages aligned to a focal point, which shield members may be alternated with open spaces between them and may have surfaces that form a circle in one axis of rotation and an ellipse in another. The **electrodes** may be supplied with a **discharge** pulse shaped to produce a modest current during the axial run out phase of the discharge and a peak occurring during the radial compression phase of the discharge. The light source may comprise a turbomol. pump having an inlet connected to the generation chamber and operable to preferentially pump more of the source gas than the buffer gas from the chamber. The source may comprise a tuned elec. conductive electrode comprising: a differentially doped ceramic material doped in a first region to at least select elec. conductivity and in a second region at least to select thermal conductivity The first region may be at or near the outer surface of the electrode structure and the ceramic material may be SiC or alumina and the dopant is BN or a metal oxide, including SiO or TiO2. The source may comprise a moveable electrode assembly mount operative to move the electrode assembly mount from a replacement position to an operating position, with the moveable mount on a bellows. The source may have a temperature control mechanism operatively connected to the collector and operative to regulate the temperature of the resp. shell members to maintain a temperature related geometry optimizing the glancing angle of incidence reflections from the resp. shell members, or a mech. positioner to position the shell members. The shells may be biased with a voltage. The debris shield may be fabricated using off **focus laser radiation.** The anode may be cooled with a hollow interior defining two coolant passages or porous metal defining the passages. The debris shield may be formed of pluralities of large, intermediate and small fins attached either to a mounting ring or hub or to each other with interlocking tabs that provide uniform separation and strengthening and do not block any significant amount of light.

ST discharge **produced plasma EUV** light source

IT **Plasma**
UV sources
(**EUV**; discharge **produced plasma** **EUV** light source)

IT Shields
(discharge **produced plasma EUV** light source)

```
L59  ANSWER 103 OF 153  COPYRIGHT THOMSON REUTERS on STN
AN   1984-006728 [02]   WPIX
TI   Gas laser using photo-ionisation to improve performance  - has
     generated field produced by generator coupled to electrode to produce
     high-speed pulse
DC   V08
IN   DE WITTE O; WITTE O
PA   (CITC-C) CILAS ALCATEL; (CILA-N) CILAS CIE IND LASER; (CILA-N) CILAS CIE
     IND LASERS SA
CYC  5
PI   DE 3322620        A  19831229 (198402)* DE  22[5]                <--
     GB 2122805        A  19840118 (198403)  EN                       <--
     FR 2529400        A  19831230 (198406)  FR                       <--
     NL 8302223        A  19840116 (198408)  NL                       <--
     GB 2122805        B  19860312 (198611)  EN                       <--
     US 4592065        A  19860527 (198624)  EN                       <--
ADT  DE 3322620 A DE 1983-3322620 19830623; FR 2529400 A FR 1982-11172
     19820625; GB 2122805 A GB 1983-17009 19830622; US 4592065 A US 1983-507634
     19830627
PI   US 4592065        A  19860527 (198624)  EN                       <--
TIEN Gas laser excited by a transverse electrical discharge triggered
     by photoionization
AG.T Sughrue, Mion, Zinn, Macpeak, and Seas
IN.T de Witte, Olivier, FR
PA.T Compagnie Industrielle des Lasers Cilas Alcatel
ABEN An X-ray generator 7 directly connected to the electrode 8 internally of a
     hollow cathode 3 emits electrons under a field effect to generate X-rays, the
     generator 7 supplying 50 to 100 Kv with a rise time of less than 10
     nanoseconds. X-rays rapidly created, in turn, rapidly create electrons in the
     active medium 1 between anode 2 and cathode 3 to trigger a discharge
     therebetween, across which anode and cathode the voltage of a laser capacitor
     is pre-applied at a level below the breakdown voltage of the active medium.
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L59 ANSWER 14 OF 153
AN 2002:107792 HCAPLUS
DN 136:142372
ED Entered STN: 10 Feb 2002
TI Plasma focus light source with active and buffer gas control
IN Melnychuk, Stephan T.; Partlo, William N.; Fomenkov, Igor V.; Ness, Richard M.; Birx, Daniel L.; Sandstrom, Richard L.; Rauch, John E.
PA USA
SO U.S. Pat. Appl. Publ., 22 pp., Cont.-in-part of U.S. Ser. No. 690,084. CODEN: USXXCO
DT **Patent**
LA English
IC ICM G01J001-00
INCL 250504000R
CC 73-11 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 74, 76
FAN.CNT 186

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE	
PI	US 20020014598	A1	20020207	US 2001-875719	20010606	<--
	~~US 6586757~~	~~B2~~	~~20030701~~			
	US 5763930	A	19980609	US 1997-854507	19970512	<--
	US 6051841	A	20000418	US 1998-93416	19980608	<--
	US 6064072	A	20000516	US 1999-268243	19990315	<--
	US 6541786	B1	20030401	US 1999-324526	19990602	<--
	US 20020100882	A1	20020801	US 1999-442582	19991118	<--
	US 6452199	B2	20020917			
	WO 2001095362	A1	20011213	WO 2001-US18680	20010607	<--
	AU 2001068288	A	20011217	AU 2001-68288	20010607	<--
	EP 1305813	A1	20030502	EP 2001-946210	20010607	<--
	JP 2004501491	T	20040115	JP 2002-502807	20010607	<--
	US 20030006383	A1	20030109	US 2002-189824	20020703	<--
	US 6815700	B2	20041109			
	US 20040108473	A1	20040610	US 2003-409254	20030408	<--
	US 6972421	B2	20051206			
	US 20040160155	A1	20040819	US 2003-742233	20031218	<--
	US 7180081	B2	20070220			
	US 20050230645	A1	20051020	US 2005-107535	20050414	<--
	US 7368741	B2	20080506			
	US 20070023711	A1	20070201	US 2006-493945	20060726	<--
	US 7291853	B2	20071106			
	US 20080023657	A1	20080131	US 2007-880319	20070720	<--
PRAI	US 1997-854507	A2	19970512	<--		
	US 1998-93416	A2	19980608	<--		
	US 1999-268243	A2	19990315	<--		
	US 1999-324526	A2	19990602	<--		
	US 1999-442582	A2	19991118	<--		
	US 2000-590962	A2	20000609	<--		
	US 2000-690084	A2	20001016	<--		
	US 2000-696084	A2	20001016	<--		
	US 2001-875719	A	20010606	<--		
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	WO 2001-US18680	W	20010607	<--		
	US 2002-120655	A2	20020410	<--		
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US 2002-419805P	P	20021018	<--
US 2002-422808P	P	20021031	<--
US 2003-384967	A2	20030308	<--
US 2003-409254	A2	20030408	<--
US 2003-742233	A3	20031218	<--
US 2005-107535	A1	20050414	

AB High energy **extreme UV** (**EUV**) photon sources are described which comprise a vacuum chamber, at least two electrodes mounted co-axially within the vacuum chamber and defining an elec. discharge region and arranged to **create** high frequency **plasma pinches** at a **pinch** site upon elec. discharge, a working gas comprising an active gas and a noble buffer gas (e.g., He), a gas control system for supplying the buffer gas and the active gas to the vacuum chamber and exhausting gas from the vacuum chamber so as to maintain the active gas at a desired concentration in the discharge region and minimize the active gas in the beam path outside the discharge region, a pulse power system comprising a charging capacitor and a magnetic compression circuit the magnetic compression circuit comprising a pulse transformer for providing elec. pulses and voltages high enough to create **elec. discharge** between the **electrodes** , a collector-director unit configured to collect **EUV** beams from the **pinch** site and direct them along a predetd. path, and a debris collector mounted near the **pinch** site and comprising narrow passageways aligned with **EUV** beams emanating from the **pinch** site and directed toward the collector-director. Preferably, active gas is injected downstream of the **pinch** region through a nozzle and exhausted axially through an exhaust port in the center of the anode. A **laser beam** may be used to generate a metal vapor (e.g., Li) active gas at a location close to but downstream of the **pinch** region and the vapor is exhausted axially through the anode. Application as a light source for **lithog.** is indicated.

ST plasma focus **extreme UV** source gas control

IT Electric discharge lamps
(plasma focus **extreme UV** sources with active and buffer gas control)

IT UV sources
(vacuum-UV; plasma focus **extreme UV** sources with active and buffer gas control)

IT 7439-93-2, Lithium, uses 7440-59-7, Helium, uses 7440-63-3, Xenon, uses
RL: DEV (Device component use); USES (Uses)
(plasma focus **extreme UV** sources with active and buffer gas control)

US006972421B2

(12) **United States Patent**
Melnychuk et al.

(10) **Patent No.:** **US 6,972,421 B2**
(45) **Date of Patent:** **Dec. 6, 2005**

(54) **EXTREME ULTRAVIOLET LIGHT SOURCE**

(75) Inventors: **Stephan T. Melnychuk**, Carlsbad, CA (US); **William N. Partlo**, Poway, CA (US); **Igor V. Fomenkov**, San Diego, CA (US); **I. Roger Oliver**, San Diego, CA (US); **Richard M. Ness**, San Diego, CA (US); **Norbert Bowering**, San Diego, CA (US); **Oleh Khodykin**, San Diego, CA (US); **Curtis L. Rettig**, Vista, CA (US); **Gerry M. Blumenstock**, San Diego, CA (US); **Timothy S. Dyer**, Oceanside, CA (US); **Rodney D. Simmons**, San Diego, CA (US); **Jerzy R. Hoffman**, Escondido, CA (US); **R. Mark Johnson**, Ramona, CA (US)

(73) Assignee: **Cymer, Inc.**, San Diego, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 107 days.

(21) Appl. No.: **10/409,254**

(22) Filed: **Apr. 8, 2003**

(65) **Prior Publication Data**

US 2004/0108473 A1 Jun. 10, 2004

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/384,967, filed on Mar. 8, 2003, which is a continuation-in-part of application No. 10/189,824, filed on Jul. 3, 2002, now Pat. No. 6,815, 700, which is a continuation-in-part of application No. 10/120,655, filed on Apr. 10, 2002, now Pat. No. 6,744,060, which is a continuation-in-part of application No. 09/875, 719, filed on Jun. 6, 2001, now Pat. No. 6,586,757, which is a continuation-in-part of application No. 09/875,721, filed on Jun. 6, 2001, now Pat. No. 6,566,668, which is a continuation-in-part of application No. 09/696,084, filed on Oct. 16, 2000, now Pat. No. 6,566,667, which is a continuation-in-part of application No. 09/590,962, filed on Jun. 9, 2000, now abandoned.

(60) Provisional application No. 60/42
2002, and provisional application
Oct. 18, 2002.

(51) **Int. Cl.**[7] ....

(52) **U.S. Cl.** .... :

(58) **Field of Search** ....

Please see claims for attached
US 6,972,421

(56) **References Cited**

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(Continued)

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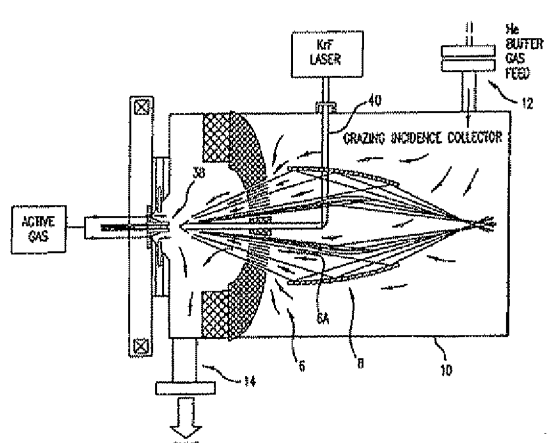
(Continued)

Primary Examiner—Kiet T. Nguyen
(74) *Attorney, Agent, or Firm*—William C. Cray; Cymar, Inc.

(57) **ABSTRACT**

The present invention provides a reliable, high-repetition rate, production line compatible high energy photon source. A very hot plasma containing an active material is produced in vacuum chamber. The active material is an atomic element having an emission line within a desired extreme ultraviolet (EUV) range. A pulse power source comprising a charging capacitor and a magnetic compression circuit comprising a pulse transformer, provides electrical pulses having sufficient energy and electrical potential sufficient to produce the EUV light at an intermediate focus at rates in excess of 5 Watts. In preferred embodiments designed by Applicants in-band, EUV light energy at the intermediate focus is 45 Watts extendable to 105.8 Watts.

78 Claims, 50 Drawing Sheets



Sheet 1 of 3

other preionizers well known in the art. Another preferred alternative is to utilize for the outer electrode an array of rods arranged to form a generally cylindrical or conical shape. This approach helps maintain a symmetrical pinch centered along the electrode axis because of the resulting inductive ballasting.

Accordingly, the reader is requested to determine the scope of the invention by the appended claims and their legal equivalents, and not by the examples which have been given.

What is claimed is:

1. A production line compatible, high repetition rate, high average power pulsed high energy photon source comprising:

A. a pulse power system comprising a pulse transformer for producing electrical pulses with duration in the range of 10 ns to 200 ns,

B. a vacuum chamber,

C. an active material contained in said vacuum chamber said active material comprising an atomic species characterized by an emission line within a desired extreme ultraviolet wavelength range,

D. a hot plasma production means for producing a hot plasma at a hot plasma spot in said vacuum chamber so as to produce at least 5 Watts, averaged over at least extreme ultraviolet radiation at wavelengths within said desired extreme ultraviolet wavelength range,

E. a radiation collection and focusing means for collecting a portion of said ultraviolet radiation and focusing said radiation at a location distant from said hot plasma spot.

2. A source as in claim 1 wherein said hot plasma production means is a dense plasma focus device.

3. The source as in claim 2 wherein said dense plasma focus device comprises coaxial electrodes.

4. The source as in claim 3 and further comprising a gas injection means for injecting active gas from a nozzle positioned on an opposite side of said hot plasma spot from said electrodes.

5. The source as in claim 2 and further comprising a capacitor means chosen to produce peak capacitor current during a plasma pinch event.

6. The source as in claim 2 wherein said dense plasma focus device comprise coaxial electrodes defining a central electrode.

7. The source as in claim 6 wherein said central electrode is an anode.

8. The source as in claim 7 wherein a portion of said anode is hollow and said anode defines a hollow tip dimension at a tip of said anode and said hollow portion below said tip is larger than said hollow tip dimension.

9. The source as in claim 7 and further comprising a sacrifice region between said electrode to encourage post pinch discharge in a region away from a tip of said anode.

10. The source as in claim 6 wherein said central electrode is water cooled.

11. The source as in claim 6 and further comprising a heat pipe for cooling said central electrode.

12. The source as in claim 6 wherein said electrodes are designed for radial run down.

13. A source as in claim 6 and further comprising a sputter source for producing sputter material to replace material eroded from at least one of said electrodes.

14. A source as in claim 13 wherein said sputter source also functions to provide preionization.

15. The source as in claim 6 wherein said central electrode is an anode defining outside walls and further comprising insulator material completely covering anode walls facing said cathode.

16. The source as in claim 15 wherein said anode also defines inner walls and comprising insulator material covering at least a portion of said inner walls.

17. The source as in claim 6 wherein said electrodes are comprised at least in part of pyrolytic graphite.

18. A source as in claim 2 and further comprising a magnetic means for applying a magnetic field to control at least one pinch parameters.

19. A source as in claim 18 wherein said parameter is pinch length.

20. A source as in claim 18 wherein said parameter is pinch shape.

21. A source as in claim 18 wherein said parameter is pinch position.

22. A source as in claim 1 wherein said hot plasma production means is a z-pinch device.

23. A source as in claim 1 wherein said hot plasma production means is a hollow cathode z-pinch.

24. A source as in claim 1 wherein said hot plasma production means is a capillary discharge device.

25. A source as in claim 1 wherein said hot plasma production means comprises an excimer laser providing a high repetition rate short pulse laser beam for generating said plasma in said vacuum chamber.

26. A source as in claim 1 wherein said hot plasma production means comprises a plasma pinch device and an excimer laser producing pulsed ultraviolet laser beams directed at a plasma produced in part by said plasma pinch device.

27. A source as in claim 1 wherein said radiation collector comprises a parabolic collector.

28. A source as in claim 1 wherein said radiation collector comprises an ellipsoidal collector.

29. A source as in claim 1 wherein said radiation collector comprises a tandem ellipsoidal mirror system.

30. A source as in claim 1 wherein said radiation collector comprises a hybrid collector comprising at least one ellipsoidal reflector unit and at least one hyperbolic reflector unit.

31. A source as in claim 30 wherein said hybrid collector comprises at least two ellipsoidal reflector units and at least two hyperbolic collector units.

32. A source as in claim 31 wherein said hybrid collector also comprises a multi-layer mirror unit.

33. A source as in claim 32 wherein said multi-layer mirror unit is at least partially parabolic.

34. A source as in claim 1 and also comprising a debris shield having narrow passages aligned with said hot plasma spot for passage of EUV light and restricting passage of debris.

35. A source as in claim 34 wherein said debris shield is comprised of hardened material surrounding passage ways left by removal of skinny pyramid shaped forms.

36. A source as in claim 34 wherein said debris shield is comprised of welded hollow cones is comprised of metal foil.

37. A source as in claim 34 wherein said debris shield is comprised of a plurality of thin laminated sheet stacked to create said passageways.

38. The source as in claim 34 and also comprising a magnet for producing a magnetic field directed perpendicular to an axis of EUV beams for forcing charged particles into a curved trajectory.

39. The source as in claim 38 wherein said magnet is a permanent magnet.

40. The source as in claim 38 wherein said magnet is an electromagnet.

41. The source as in claim 34 wherein said debris shield is a honeycomb debris shield.

Sht 2 of 3

42. The source as in claim **41** wherein said honeycomb debris shield comprises hardened plasticized powder batch material.

43. The source as in claim **42** wherein said powder batch material is hardened by sintering.

44. The source as in claim **34** and further comprising a gas control system to create a gas flow in said vacuum chamber through at least a portion of said debris shield in a direction opposite a direction of EUV light through said debris shield.

45. The source as in claim **44** wherein gas flows through said debris shield in two directions.

46. The source as in claim **34** and further comprising a shutter with a seal located between said debris shield and said radiation collector to permit replacement of electrodes and the debris shield without loss of vacuum around said radiation collector.

47. A source as in claim **46** and further comprising an electrode set arranged as a module with said debris shield so that the electrode set and the debris shield can be easily replaced as a unit.

48. The source as in claim **1** wherein said active material is chosen from a group consisting of xenon, tin, lithium, indium, cadium and silver.

49. The source as in claim **1** wherein said vacuum chamber contains, in addition to said active material, a buffer gas.

50. The source as in claim **49** wherein said buffer gas is chosen from a group consisting of helium and neon.

51. The source as in claim **49** wherein said buffer gas comprises hydrogen.

52. The source as in claim **1** wherein said active material is injected into said vacuum chamber through an electrode.

53. The source as in claim **1** wherein said active material is introduced into said vacuum chamber as a compound.

54. The source as in claim **53** wherein the compound is chosen from a group consisting of Li_2O, LiH, LiOH, LiCl, Li_2Co_3, LiF, CH_3OLi and solutions of any materials in this group.

55. The source as in claim **1** and further comprising a laser for vaporizing said active material.

56. The source as in claim **1** and further comprising an RF source for sputtering active material into a location within or near said hot plasma spot.

57. The source as in claim **1** and further comprising a preionization means.

58. The source as in claim **57** wherein said preionization means comprises spark plug type pins.

59. The source as in claim **57** wherein said preionization means comprises an RF source.

60. The source as in claim **57** wherein said active material is preionized prior to injection into said vacuum chamber.

61. The source as in claim **60** wherein said preionization means comprises a radiation means for directing radiation to a nozzle to preionize active material prior to its leaving said nozzle to enter said vacuum chamber.

62. The source as in claim **1** wherein said active material is lithium contained in porous tungsten.

63. The source as in claim **62** and further comprising an RF means driving lithium atoms out of said porous tungsten.

64. The source as in claim **1** wherein said source is positioned to provide EUV light to a lithography machine.

65. The source as in claim **64** wherein a portion of said source is integrated into said lithography machine.

66. A source as in claim **1** wherein said means for producing a hot plasma is sufficient to produce at least 45.4 Watts at an intermediate focus.

67. A source as in claim **1** wherein said means for producing a hot plasma is sufficient to produce at least 105.8 Watts at an intermediate focus.

68. A source as in claim **1** wherein said active material is chosen to produce EUV radiation within a wavelength band within about 2% of 13.5 nm.

69. A source as in claim **1** wherein said pulse power system is operating at repetition rates of at least 6,000 pulses per second.

70. A source as in claim **1** wherein said pulse power system is operating at repetition rates of at least 10,000 pulses per second.

71. A source as in claim **1** wherein said radiation collector is designed to produce homogenization of said EUV radiation.

72. A source as in claim **1** wherein said active material is delivered to regions of said hot plasma spot as a metal in fluid form.

73. A source as in claim **72** wherein said fluid form is liquid.

74. A source as in claim **72** wherein said fluid form is a solution.

75. A source as in claim **72** wherein said fluid form is a suspension.

76. A source as in claim **1** wherein EUV light produced by electrons impact an electron material is collected along with EUV light from said plasma hot spot.

77. A source as in claim **1** wherein said active material is a metal vapor produced by sputtering.

78. A source as in claim **1** wherein said active material is chosen to produce high energy radiation light in the range of 0.5 nm to 50 nm.

* * * * *

L59 ANSWER 15 OF 153 COPYRIGHT ACS on STN
AN 2001:933038 HCAPLUS
ED Entered STN: 27 Dec 2001
TI Plasma focus light source with tandem ellipsoidal mirror units
IN Birx, Daniel L.; Rauch, John E.; Partlo, William N.; Fomenkov, Igor V.; Ness, Richard M.; Sandstrom, Richard L.; Melnychuk, Stephan T.
PA Cymer, Inc., USA; Birx, Deborah L.
SO PCT Int. Appl.
CODEN: PIXXD2
DT **Patent**
LA English
IC ICM H01J035-20
FAN.CNT 186

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	WO 2001099143	A1	20011227	WO 2001-US18758	20010607 <--
	US 20020014599	A1	20020207	US 2001-875721	20010606 <--
	AU 2001066831	A	20020102	AU 2001-66831	20010607 <--
PRAI	US 2000-590962	A	20000609 <--		
	US 2000-690084	A	20001016 <--		
	US 2001-875721	A	20010606 <--		
	US 1997-854507	A2	19970512 <--		
	US 1998-93416	A2	19980608 <--		
	US 1999-268243	A2	19990315 <--		
	US 1999-324526	A2	19990602 <--		
	US 1999-442582	A2	19991118 <--		
	WO 2001-US18758	W	20010607 <--		

AB A high energy photon source. A pair of **plasma pinch** electrodes **forming** a **plasma pinch** source (46) are located in a vacuum chamber. The chamber contains a working gas which includes a noble buffer gas and an active gas chosen to provide a desired spectral line. A pulse power source provides elec. pulses at repetition rates of 1000 Hz or greater and at voltages high enough to create **elec. discharges** between the **electrodes** to produce very high temperature, high d. plasma **pinches** in the working gas providing radiation at the spectral line of the source or active gas. A fourth generation unit is described which produces 20 mJ, 13.5 nm pulses into 2 pi steradians at repetition rates of 2000 Hz with xenon as the active gas. This unit includes a pulse power system (404) having a resonant charger charging a capacitor bank, and a magnetic compression circuit comprising a pulse transformer (406) for generating the high voltage elec. pulses at repetition rates of 2000 Hz or greater.

L59 ANSWER 12 OF 153 COPYRIGHT ACS on STN
AN 2002:946805 HCAPLUS
DN 138:30876
ED Entered STN: 13 Dec 2002
TI Star **pinch** plasma source of photons or neutrons
IN McGeoch, Malcolm W.
PA Plex LLC, USA
SO U.S. Pat. Appl. Publ., 26 pp., Cont.-in-part of U.S. Ser. No. 876,469.
CODEN: USXXCO
DT **Patent**
LA English
IC ICM H01J035-00
INCL 378119000
CC 73-11 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 71, 76
FAN.CNT 2

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	US 20020186815	A1	20021212	US 2002-165998	20020610 <--
	US 6728337	B2	20040427		
	US 20020186814	A1	20021212	US 2001-876469	20010607 <--
	US 6567499	B2	20030520		
PRAI	US 2001-876469	A2	20010607 <--		
	US 2002-361118P	P	20020301 <--		

AB Sources of photons or neutrons are described which comprise a housing that defines a discharge chamber, a first group of ion beam sources directed toward a plasma discharge region in the discharge chamber, the first group of ion beam sources including a first electrode and an inner shell, a second **electrode** spaced from the plasma **discharge** region, a first power supply for energizing the first group of ion beam sources to electrostatically accelerate toward the plasma discharge region ion beams which are at least partially neutralized before they enter the plasma discharge region, and a second power supply coupled between the first and second electrodes for delivering a heating current to the plasma discharge region. The ion beams and the heating current **form** a hot **plasma** that radiates photons or neutrons. The source of photons or neutrons may further include a second group of ion beam sources. The photons may be in the **soft x-ray** or **extreme UV** wavelength ranges.
ST x ray source star **pinch** plasma; **extreme UV** source star **pinch** plasma; neutron source star **pinch** plasma
IT Electric discharge devices
Neutron **generators**
X-ray sources (devices)
(star **pinch plasma** photon or neutron sources)
IT UV sources
(vacuum-UV; star **pinch** plasma photon or neutron sources)
IT 1333-74-0, Hydrogen, uses 7439-90-9, Krypton, uses 7439-93-2, Lithium, uses 7440-01-9, Neon, uses 7440-37-1, Argon, uses 7440-59-7, Helium, uses 7440-63-3, Xenon, uses 7727-37-9, Nitrogen, uses 7782-44-7, Oxygen, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(star **pinch** plasma photon or neutron sources)

L59 ANSWER 88 OF 153 COPYRIGHT THOMSON REUTERS on STN
AN 1995-046459 [07] WPIX
DNN N1995-036680 [07]
TI Apparatus for **X-ray generation** - uses plasma composition element arranged near **discharge electrode** as **target** for **laser** pulse generated from light source
DC V05
IN KITAHARA T; SASABE J
PA (HAMM-C) HAMAMATSU PHOTONICS KK
CYC 1
PI JP 06325708 A 19941125 (199507)* JA 5[4] <--
ADT JP 06325708 A JP 1993-116031 19930518
PRAI **JP 1993-116031 19930518**
IPCR H01J0035-00 [I,C]; H01J0035-22 [I,A]
AB JP 06325708 A UPAB: 20050511

The **X-ray generation** apparatus has a trigger signal generation unit (22). A trigger signal is simultaneously sent to a **laser light source** (19) and a delay apparatus (28). A high voltage trigger unit (27) sends a high voltage pulse to spark air gap switch (25) the **laser light source** (19) emits a **laser** pulse directed towards a **target** (16). When the spark air gap switch closes all the accumulated charge gets transferred to a charge unit (26) through an electrostatic capacitor bank (24). The target includes a a plasma composition element. The wavelength of the **generated X-ray** depends on the material of the target.

ADVANTAGE - Increases repeatability of operation. Decreases fluctuation of light emitting source. Increases efficiency of generation of X-rays. Increases optical intensity of generated X- rays.

L59 ANSWER 57 OF 153
AN 2003-776969 [73] WPIX
CR 2003-275900
DNC C2003-213651 [73]
DNN N2003-622583 [73]
TI **Soft X-ray** ultraviolet photon source has neutralization mechanism for neutralizing ion beam accelerated by two groups of ion beam sources, before beam enters plasma discharge region
DC L03; V05
IN MCGEOCH M W
PA (PLEX-N) PLEX LLC
CYC 1
PI US 20020186814 A1 20021212 (200373)* EN 13[6] <--
US 6567499 B2 20030520 (200373) EN <--
ADT US 20020186814 A1 US 2001-876469 20010607
PRAI **US 2001-876469 20010607**
IPCR G03F0007-20 [I,A]; G03F0007-20 [I,C]; **H05G0002-00** [I,A]; **H05G0002-00** [I,C]
EPC G03F0007-20T12; H05G0002-00P2
NCL NCLM 378/119.000
NCLS 378/125.000
AB US 20020186814 A1 UPAB: 20050601
NOVELTY - Two groups of ion beam sources arranged in a chamber (504), accelerate a beam of ions of gas e.g. xenon towards a plasma **discharge** region (120). The sources act as **anode** and **cathode** to deliver heating current to **discharge** region. A neutralizing mechanism neutralizes the beams before they enter discharge region, so that neutralized beams and current **form** a hot **plasma** that radiates photons.
DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for the following: (1) system for generating photons; and (2) method for generating photons.
USE - To **generate soft X-ray** ultraviolet photons.
ADVANTAGE - Improves the productivity of photons by electrostatic acceleration of ions. Avoids space charge repulsion by neutralizing the ions. Also raises the temperature and density of the **plasma** by **heating.**
DESCRIPTION OF DRAWINGS - The figure shows the schematic view of the system for generating photons.
electrode shells (112,114)
plasma discharge region (120) acceleration structure (500) discharge chamber (504)
gas source (520)
pulse source (530)

L59 ANSWER 13 OF 153 COPYRIGHT ACS on STN
AN 2002:141828 HCAPLUS
DN 136:270101
ED Entered STN: 22 Feb 2002
TI Fast collisional capillary discharge source for **soft x-ray production** and applications
AU Tomassetti, Giuseppe; Palladino, Libero; Ritucci, Antonio; Reale, Lucia; Limongi, Tania; Kukhlevsky, Sergei V.; Kaiser, Jozef; Flora, Francesco; Mezi, Luca
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SO Proceedings of SPIE-The International Society for Optical Engineering (2001), 4504(Applications of X Rays Generated from Lasers and Other Bright Sources II), 151-158
CODEN: PSISDG; ISSN: 0277-786X
PB SPIE-The International Society for Optical Engineering
DT Journal
LA English
CC 73-11 (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
Section cross-reference(s): 76
AB The authors report on a fast **soft x-ray** source consisting in a high temperature small diameter **plasma** column **produced** by elec. discharge in a ceramic capillary. This source was developed to produce pulses of few hundred **nanosecond** duration for **EUV lithog.**, x-ray microscopy applications and also with the aim of developing a **soft x-ray** amplifier. The authors obtained exptl. results concerning the intensity and spectral anal. of the emitted x radiation pumped by a 30-40 kA, 100-200 ns, elec. discharge at 1 torr pressure in Ar gas. The authors refer also on the spectra obtained using CO2, as plasma medium, after the optimization of the discharge setup and elec. parameters.
ST **soft x ray** source capillary Z **pinch** discharge argon; carbon dioxide **soft x ray** source capillary Z **pinch**; alumina capillary Z **pinch** **soft x ray** source; vacuum UV source capillary Z **pinch**; current voltage capillary Z **pinch** UV x ray source
IT **Pinch** plasmas
(Z-**pinch**; fast collisional capillary discharge source for **soft x-ray production** and applications)
IT **Electric discharge**
(capillary; **fast** collisional capillary discharge source for **soft x-ray production** and applications)
IT Electric current-potential relationship
Vacuum UV spectra
X-ray sources (devices)
(fast collisional capillary discharge source for **soft x-ray production** and applications)
IT 124-38-9, Carbon dioxide, uses 1344-28-1, Alumina, uses 7440-37-1, Argon, uses
RL: DEV (Device component use); USES (Uses)
(fast collisional capillary discharge source for **soft x-ray production** and applications)

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DN 138:392072
ED Entered STN: 21 May 2003
TI Discharge **produced plasma** light sources. Present status of discharge **produced plasma** light sources development
AU Hotta, Eiki
CS Department of Energy Sciences, Tokyo Institute of Technology, Yokohama, ~~226-8502, Japan~~
SO Purazuma, Kaku Yugo Gakkaishi (2003), 79(3), 245-251
CODEN: PKYGE5; ISSN: 0918-7928
PB ~~Purazuma, Kaku Yugo Gakkai~~
DT ~~Journal;~~ General Review
LA Japanese
CC ~~73-0~~ (Optical, Electron, and Mass Spectroscopy and Other Related Properties)
~~Section~~ cross-reference(s): 74, 76
AB A review. The present status of the development of light sources based on discharge for **EUV lithog.** is reviewed. The discharges, such as Z-**pinch**, capillary **discharge.** plasma focus and hollow **cathode discharge**, are compared and their significant features are pointed out. The performance of each type of discharge is summarized. The plans and the present state of the development of **EUV** high sources at Tokyo Institute of Technol. and Kumamoto University are briefly described.
ST review **UV extreme lithog** discharge **produced plasma** light source
IT **Photolithography**
(UV; discharge **produced plasma** light source development)
IT **Plasma**
(discharge **produced plasma** light source development)
IT Light sources
(discharge **produced plasma** light sources)
IT UV sources
(vacuum-UV; discharge **produced plasma** light source development)